Module 4 - Strain Gauges

ME3050 - Dynamics Modeling and Controls

Mechanical Engineering

Tennessee Technological University

Topic 1 - Measuring Strain

Topic 1 - Measuring Strain

- Motivation in Design
- Stress and Strain
- The Strain Gauge
- Engineering Applications

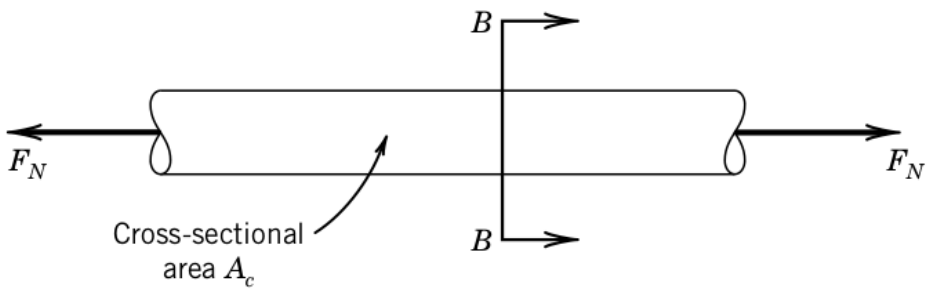
Motivation in Design

The design of load-carrying components for machines and structures requires information concerning the distribution of forces within the particular component. Proper design of devices such as shafts, pressure vessels, and support structures must consider load-carrying capacity and allowable deflections. Mechanics of materials provides a basis for predicting these essential characteristics of a mechanical design, and provides the fundamental understanding of the behavior of load-carrying parts. However, theoretical analysis is often not sufficient, and experimental measurements are required to achieve a final design.

Text: Theory and Design of Mechanical Measurements

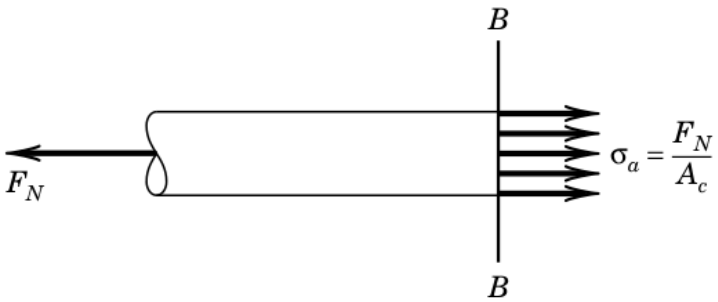
Stress and Strain

Consider a member under uni-axial loading. The strain is defined as the ratio of the change in length to the original length of the component.



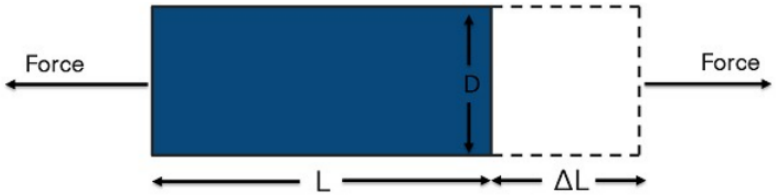
$$\sigma_a = \frac{F_N}{A_c}$$

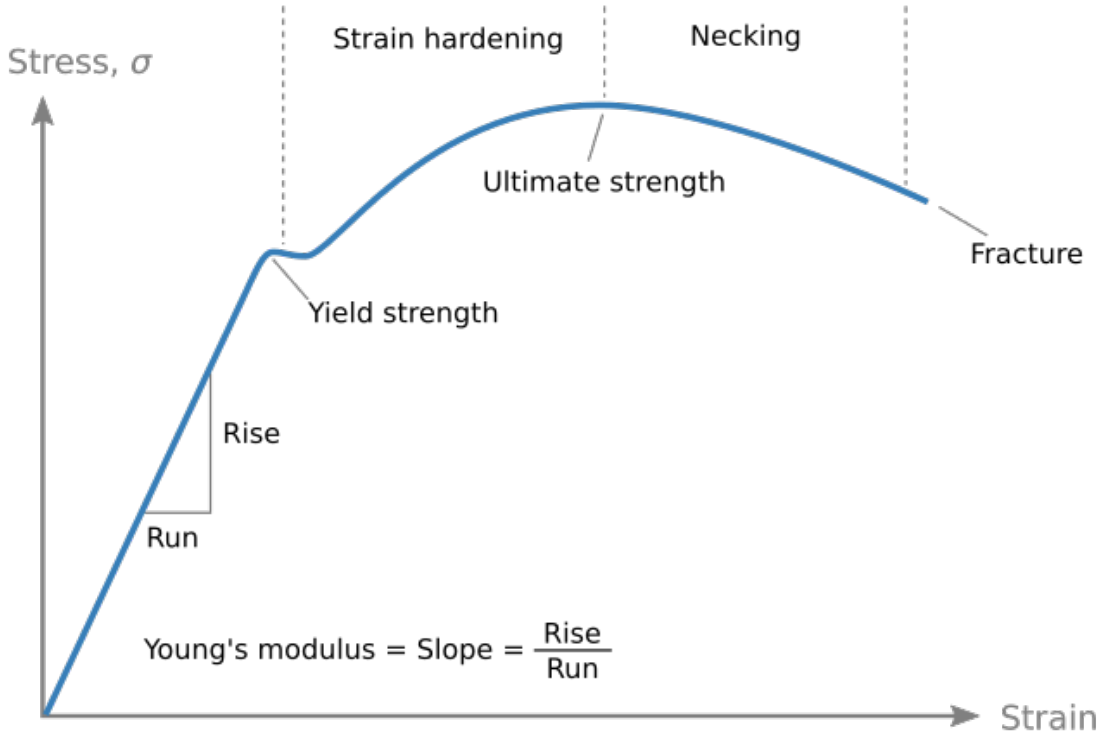
$$\epsilon_a = \frac{\delta_L}{L}$$



$$\sigma_a = E_m \epsilon_a$$

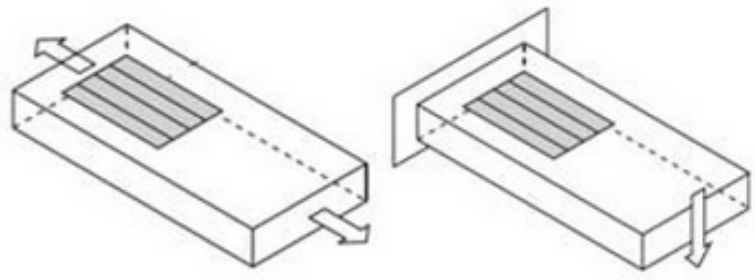
Stress and Strain





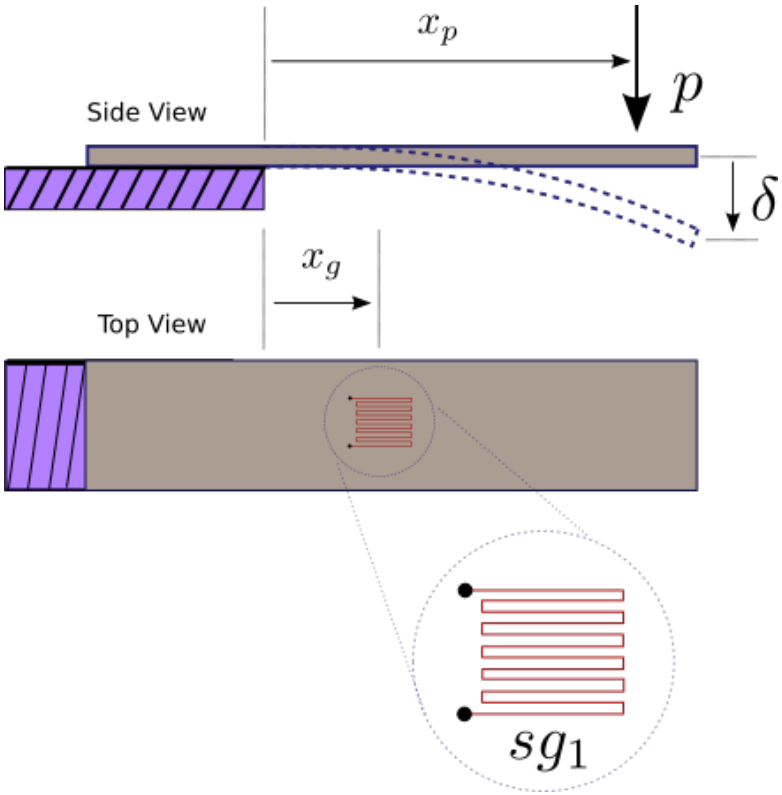
The Strain Gauge

... the ideal sensor for the measurement of strain would (1) have good spatial resolution, implying that the sensor would measure strain at a point; (2) be unaffected by changes in ambient conditions; and (3) have a high-frequency response for dynamic (time-resolved) strain measurements. A sensor that closely meets these characteristics is the bonded resistance strain gauge.



The Strain Gauge

Strain gauges can be mounted in different ways for different purposes. We will begin with a single gauge mounted in the axial direction.



Engineering Applications

- Segway back to *Motivation in Design* (Slide 1) ...
- Aerospace
- Infrastructure
- Please read this article here. We will cover the mathematics and theory in class but this article has a short section on applications of strain gauges that I want you to see.